Swami Ramanand Teerth Marathwada University,
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Ph. D. Synopsis in Zoology

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Topic of Research : " **Studies on Impact of Different Types of Diet on Growth and Reproductive Performance of Goldfish, *Carassius auratus* under Captive Conditions "**

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Topic of Research

"Studies on Impact of Different Types of Diet on Growth and Reproductive Performance of Goldfish, *Carassius auratus* under Captive Conditions"

Introduction

Ornamental fishes are attractive and colorful species of fishes of a peaceful nature that can be maintained alive as pets in confined space of an aquarium or garden pool, when maintained for the purpose of enjoying their beauty (Mukherjee *et. al.*, 2000; Singh and Ahmed, 2005). They are often called as the "living jewels" due to their colour, shape, behaviour etc. (Das *et. al*, 2005). The attractive colouration and quiet disposition of ornamental fish provide a source of joy and peace for people, irrespective of age groups.

At present, ornamental fishes are the most popular pets throughout the world (Singh, 2005). Ornamental fish keeping is becoming popular as an easy and stress relieving hobby (Ghosh *et. al.*, 2003) and is emerging as one of the most popular hobbies across the world, next to photography (Das *et. al*., 2005; Singh and Ahmed, 2005).

On the other hand aquarium fish culture is being practiced all over the country to meet the domestic needs but not on commercial lines to meet the export demands. In spite of having the advantage of tropical climate and vast potential of aquatic resources, it is said that India is contributing only one percent to the global trade in ornamental fish industry.

Although the aquarium market is flooded with imported feeds, small scale farmers can not afford to buy them due to high cost. In rural areas the farmers themselves find alternate low cost live foods such as Daphnia, green water and infusoria as larval feeds. In areas where salt pans are available, the farmers use Artemia nauplii to fees the young ones. The brooders are feed with blood worms, tubifix and prepared feeds.

Generally farmers prepare farm moist feeds using raggi, wheat bran, rice bran, ground nut oil cake and locally available cheap non-conventional ingredients. By doing so, they are able to save 25-28% of feed cost.

Various types artificial feeds are available in the market with different trade names some of them are Indian made and most of them are imported. They are costly and unaffordable to

beginner aquarium keeper. There is no easily alternative available for such type costly feeds. Also their impacts (growth, survival, fecundity, reproduction etc) on ornamental fishes were not reported.

Live feeds culture and use for ornamental fishes (Zooplanktons, phytoplanktons, Spirulina, brine shrimp larvae, Daphnia). The small scale farmers cannot afford to buy readymade pellet feeds or brine shrimp larvae. So much so they have successfully substituted low cost alternative live feeds i.e. green water, water fleas, tubifix or sludge worm, mosquito larvae and chopped earthworms.

In view of that in the present proposal aim is to study the impacts of different types feeds (artificial as well as live feeds) on goldfish, *Carassius auratus*. And also prepare the feed by using locally available ingredients so as to prepare the balanced feed and lost cost.

Goldfish, *Carassius auratus* (Linnaeus) one of the best aquarium fish world wide is native of central Europe. It was introduced into the Ooty Lake in Madras in 1874 from Central Europe for the experimental purpose. It belongs to the family Cyprinidae and is closely related to Indian major carps. Goldfish is good model for conducting basic research work in laboratory conditions. On the basis of these results further trials were taken on other carp species those are not bred in captivity like Indian major carps, Chinese carps etc on fields.

Limited data exist for growth parameters of ornamental fish including Goldfish, although some information is available for carp species. In view of this, in the present study Goldfish, *Carassius auratus*, were selected for the proposed work.

Review of Literature

Aquarium keeping is an age old practice and has become one of the most popular hobbies. As on high demand, throughout the world, rearing and marketing of the ornamental fishes for the aquarium can be taken up as a means of amiable livelihood. It was during the Sung dynasty, about 1000 years ago, when the Chinese first began to domesticate gold fishes. Later on these fishes were transported to the other places in the world. Glass aquaria were first used by the Romans. During 18th century, gold fishes were transported to England and keeping them in glass bowls became a popular hobby.

Ornamental or aquarium fishes form an important commercial component of fisheries, providing for aesthetic requirements and upkeep of the environment. Little information exists that dates the origin of ornamental fish culture, but it can be assumed that it was developed in Chine, where the goldfish was cultured traditionally as ornamental fish (believed to have been somewhere in the year 2000 B.C). Modern aquarium keeping of fish began in 1805 with the first public display aquarium opened at Regent`s Park in England in 1853. One of the best facilities in this part of the world exists at Singapore that is located on the Sentosa Island. Initially called Oceanarium with room-sized aquaria is now totally renovated and designated the Corallium with a tunnel like facility where one moves on the horizontal escalator with all kinds of large marine fish around him.

About 80% of the world`s ornamental fishes that are traded come from the freshwater resources, 20% being the marine species whose contribution is increasing with advances in breeding and rearing technology.

Taking a few moments off daily chore, it is not bad watching a small aquatic home with glassy walls. Colourful enchanting members that enhance the décor of the place are seen moving inside it. These lovable members are, of course, the ornamental fishes inside an aquarium, which represent a natural ecosystem. Watching fishes inside an aquarium refreshes one’s mind, remove stress of the modern day life and allows one to deep into a fish’s world.

Keeping fish in an aquarium at home is a popular hobby for many people. Usually fish aquarium is kept in the room for decorative purpose, but fish are maintained in the laboratory for scientific studies also. Culture of ornamental fishes also provides jobs to many people

Spirulina is used in aquaculture as a liquid feed for young fish and a dehydrated feeds for adult fish. Spirulina contains 60-70% protein (by weight) and is a rich source of vitamins B-12 and beta carotene (20 times greater that carrot), minerals, essential amino acids (62%) and fatty acids. Spirulina improves the intestinal flora in fish by braking down indigestible feed components to extract more nutrients from the feed. Spirulina stimulates the production of enzymes that transport fats within the fish for growth instead of storage (James et al., 2006). The cell wall of spirulina is rich in mucoproteins and enhances the natural mucous layer of the skin, resulting in a shiny appearance of the fins and skin and improved resistance to infection (Venkataraman, 1993). Vitamin E functions as lipid-soluble antioxidant, protecting biological

membranes, lipo-proteins, and lipid stores against oxidation (Hamre and Lie, 1995). Several studies have demonstrated the individual effects of spirulina and vitamin E on growth, survival, skeletal deformities, reproduction and immune responses in various ouganisms(Gupta et al., 1987; Braun, 1988; James et al., 2006).

The goldfish (*Carassius auratus auratus*) is a freshwater fish in the family Cyprinidae of order Cypriniformes. It was one of the earliest fish to be domesticated, and is one of the most commonly kept aquarium fish. A relatively small member of the carp family (which also includes the koi carp and the crucian carp), the goldfish is a domesticated version of a less-colorful carp (Carassius auratus) native to East Asia. It was first domesticated in China more than a thousand years ago, and several distinct breeds have since been developed. After hatching the first three days no artificial feed is required. From the 4^{th} day onwards green water and infusoria (raised from a mix of cattle dung and banana leaves) provided to the hatchlings 2-3 times a for the first four days, from the 5^{th} days onwards the feeding was done with zooplankton and artificial diet composed of rice bran : mustard cake : suji (1:1:2). Mature brooders (males showing white tubercles on operculum and milt freely oozing out and females having distended abdomen and eggs coming out). In case of freshwater tropical species generally the farmers consider that for each 1 cm of fish length 20 sq.cm of surface area is sufficient.

The increasing demand and the lucrative trade that generates income, provides employment and diversifies aquaculture has opened up the flood gates of a booming business for the Indian small and large scale.

Objectives

- To investigate the influence of different types of feeds (live and dry) on the goldfish, *Carassius auratus* (growth, survival, gonadosomatic index, fecundity, reproduction etc.) and to identify the perfect composition of feed for optimum response.
- To determine whether commercially available dry diets, prepared diets or live feed were capable of producing superior growth in Goldfish.
- To prepare the diets by using locally available ingredients.
- To prepare the fish feeds with economic considerations.

■ To develop the aquarium setup for ornamental goldfish, considering various developing stages and develop breeding setup.

Methodology to be adopted

■ Water analysis by using standard methods viz. DO, pH, TDS, TS, etc.

■ Feed formulations, Analysis Feed Conversion Ratio

■ Techniques of rearing ornamental fishes in aquarium

■ Analysis of growth performance, reproductive performance.

■ Identification of planktons

■ Development of techniques for aquarium keeping

■ Use of statistical methods like Student's T test, ANNOVA for significance of work

Importance of study / Society application

►The ornamental fish farming is a hobby-based aquaculture industry worldwide.

►It is multimillion dollar industry that supports thousands of rural people in developing countries.

►In many developing countries the culture of ornamental fish provides income and self employment to the people.

►According to psychiatrists, placing aquaria with ornamental fishes in the vicinity of patients could even treat certain types of mental disorders (Saroj Swain, 2008).

►Ornamental fishes are the most popular pets throughout the world.

►Ornamental fish keeping is becoming popular as an easy and stress relieving hobby and is emerging as one of the most popular hobbies across the world, next to photography.

►Ornamental fish culture develop the employment generation for the unemployed citizens.

►It is best employment for rural families particular women's are involved in this business on small scale (domestic).

►Scope for development of new feeds for ornamental fish industry.

►It creates a self-employment opportunity

►Increases Survival rate & length & weight gain

International Status

Ornamental fish culture also known as aquariculture, is the culture of attractive, colorful fishes of peaceful nature in confined aquatic systems. Ornamental fishes are also called as "living jewels". Aquarium fish keeping is a centuries-old popular hobby, growing interest in which has resulted in steady expansion in its trade in more than 125 countries.

Starting in ancient China, various species of carp (collectively known as Asian carps) have been domesticated and reared as food fish for thousands of years. Some of these normally gray or silver species have a tendency to produce red, orange or yellow color mutations; this was first recorded in the Jin Dynasty (265-420) (Roots Clive (2007).

Ornamental fish keeping in the Far East dates back to over a thousand years ago, in Europe since the early 17th century. Only a few hundred of the 4000–5000 fish species currently being kept as pet fish worldwide are very popular and commonly kept by a large number of fish hobbyists, whereas specialist-hobbyists and zoos are often involved with the rare species (Pannevis, 1993). The implementation of ornamental fish breeding and rearing still relies greatly upon fish sourced from the wild, as wild populations are historically where the majority of ornamental fish have been sourced from with well-established collection industries. However, due to popular demand and pressure on wild resources, farming of ornamental fish, especially the tropical live-bearers (guppies, swordtails, mollies), is now an established industry in countries such as Singapore. This review was written to give insight into nutrient requirements of ornamental fish, firstly under commercial farming conditions that concentrate on maximum growth rate, and thereafter in a public or home aquaria environment where fish are kept for display and emphasis shifts to other variables such as colouration and gonad maturation (breeding health), rather than fast growth. It concentrates on scientific sound studies specifically related to nutrition of species used in the ornamental fish trade, as the basic general principles of fish nutrition and nutrition of food fishes

During the Tang Dynasty (618–907), it was popular to raise carp in ornamental ponds and watergardens. A natural genetic mutation produced gold (actually yellowish orange) rather than silver coloration. People began to breed the gold variety instead of the silver variety, keeping them in ponds or other bodies of water. On special occasions at which guests were expected they would be moved to a much smaller container for display.

By the Song Dynasty (960–1279), the domestication of goldfish was firmly established (Smartt, Joseph (2001). In 1162, the empress of the Song Dynasty ordered the construction of a pond to collect the red and gold variety. By this time, people outside the imperial family were forbidden to keep goldfish of the gold (yellow) variety, yellow being the imperial color. This is probably the reason why there are more orange goldfish than yellow goldfish, even though the latter are genetically easier to breed.

During the Ming Dynasty (1368-1644), goldfish also began to be raised indoors (Roots Clive (2007) which led to the selection for mutations that would not be able to survive in ponds. The occurrence of other colors (apart from red and gold) was first recorded in 1276. The first occurrence of fancy-tailed goldfish was recorded in the Ming Dynasty. In 1603, goldfish were introduced to Japan, where the Ryukin and Tosakin varieties were developed. In 1611, goldfish were introduced to Portugal and from there to other parts of Europe.

During the 1620s, goldfish were highly regarded in southern Europe because of their metallic scales, and symbolized good luck and fortune. It became tradition for married men to give their wives a goldfish on their one-year anniversary, as a symbol for the prosperous years to come. This tradition quickly died, as goldfish became more available, losing their status. Goldfish were first introduced to North America around 1850 and quickly became popular in the United States (Brunner Bernd, 2003). A western aquarium of the 1850s of the type that contained goldfish among other coldwater species

Ornamental fish are in greater demand due to their easy maintenance in houses, offices and commercial centers and the scope for their production on large-scale is increasing day-by-day. It is reported that Singapore earns more than Rs. 2000 crores from this trade, Sri Lanka is getting about Rs. 100 crores annually and India earnings are less than Rs. 25 crores (Devaraj, 2000). There is a constant demand for these beautiful ornamental fishes from European countries, America and Canada. The demand for ornamental fishes within and outside the country has been increasing rapidly during the recent years.

National Status

India is blessed with a rich diversity of freshwater fishes both in the Western Ghats and North Eastern hills. The Western Ghats of India is one of the 34-Biodiversity 'hotspot' areas of the World (Anna Mercy, 2007). Among the 300 species of freshwater fishes in the Western Ghats, 155 are considered ornamental fishes of which 117 are endemic to the Western Ghats. At present, only a small fraction of the endemic fish diversity is utilized in ornamental fish trade.
The growing interest in aquarium fishes has resulted in steady increase in aquarium fish trade globally.

Over 500 species of ornamental fishes are available in Indian waters, about 300 in marine and over 200 in freshwaters, of the latter around 100 species each are known from the Western Ghats and the north eastern India.

Amongst the marine ornamentals, 165 species belonging to 20 families have been intensively studied and found to hold a great promise for export. Of the fresh water ones, 53 species from north-eastern India have been designated to have a great potential for domestic and international trade that would help in the development of rural economy with special opportunities for the gender sensitive region with the matriarch system.

India`s contribution to the world trade in ornamental fish is an insignificant 1% while Singapore, Chine (Hong Kong), Malaysia, Srilanka, Japan and the Philippines occupy a position amongst the world`s top ten exporting countries. Indian waters can be considered a "JEWEL MINE" for traders and hobbyists of ornamental fish. In India, the total value of ornamental fish exported stand at about Rs.30 million (US $ 1.14 million), although the potential is very high. In the year 2004, India exported ornamental fishes to the tune of Rs. 100 million (US $ 2.2 million).Ornamental fish trade started in India in 1969 with export earning of US $ 0.04 million. It grew to worth US $0.12 million by 1989. Presently about 210 species of indigenous ornamental fishes are being exported to different countries.

India is still in a marginal position of just contributing 1% of total global ornamental fish trade. In tropical climate in India is ideal for breeding and growing a wide variety of ornamental fishes. India has a potential to increase the supply of ornamental fishes to the world market.
In India, Kolkata, Mumbai and Chennai are the major production centers (Business Line, Financial Daily, August 21, 2001). The annual demand for ornamental fishes in India is always more than production.

Proposed Work Plan / Formulation and Structure of Study

- **First Year**: Course work, Review of Literature, setting of aquarium, experimental setup, purchase of goldfish etc.
- **Second Year**: Rearing of goldfish, study of commercially available artificial feeds, contents, study of influence of artificial feeds on goldfish growth, survival, feed conversion ration, reproduction.
- **Third Year:** To study the impacts of live feeds on goldfish, combination of live feeds and dry feed for Goldfish. Preparation of feeds by using locally available nutrients and check their impacts on goldfish for various parameters (growth, fecundity, reproduction etc).
- **Fourth Year**: Result writing and data analysis, publication of research paper, thesis writing and submission to university.

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